REMARKS

In accordance with the foregoing claim 12 has been amended and claims 1-5, 7, 8, 11 and 12 are pending and under consideration. Claims 1, 11 and 12 are the independent claims. No new matter is presented in this Amendment. Proper support for the amendment to claim 12 can be found in the specification at least at paragraphs [0033] through [0036].

REJECTIONS UNDER 35 U.S.C. §103:

Claims 1-5, 7, 8, 11, and 12 are rejected under 35 U.S.C. §103(a) as being unpatentable over Mitanaga et al. (U.S. Patent 5,923,997) in view of Shimizu et al. (U.S. 6,255,146).

Regarding the rejection of independent claim 1, it is noted that claim 1 recites a display device with a polysilicon substrate comprising, amongst other novel features, primary crystal grain boundaries inclined to a first direction of current flowing from source to drain of each of the first plurality of thin film transistors at an angle of -30° to 30° and the secondary crystal grain boundaries are inclined to a second direction of current flowing from source to drain of each of the first plurality of thin film transistors, and primary crystal grain boundaries are inclined to the second direction of current flowing from source to drain of each of the second plurality of thin film transistors at an angle of 30° to 150° and the secondary crystal grain boundaries are inclined to the first direction of the current flowing from source to drain of each of the second plurality of thin film transistors.

Applicants respectfully assert that the combination of Mitanaga and Shimizu fails to disclose each of these features.

In detail, the Office Action states that Mitanaga is silent with regards to the limitation of the secondary crystal grain boundaries inclined to a second direction of current flowing from source to drain of each of the first plurality of thin film transistors, and the secondary crystal grain boundaries are inclined to the first direction of the current flowing from source to drain of each of the second plurality of thin film transistors (page 3, lines 10-13). The Office Action further states that one skilled in the art would reasonably contemplate modifying the device of Mitanaga to include the claimed secondary crystal grain boundaries inclined to a second direction of current flowing from source to drain of each of the first plurality of thin film transistors, and the secondary

crystal grain boundaries inclined to the first direction of the current flowing from source to drain of each of the second plurality of thin film transistors, as an obvious matter of design engineering as evidenced by Shimizu. The Office Action finally states that Shimizu teaches crystal grain boundaries perpendicular to other crystal grain boundaries in many different ways, and Shimizu makes no distinction between primary and secondary boundaries and therefore as illustrated in Fig. 44 teaches the described claimed secondary boundaries.

First, it is noted that Fig. 44 is a mid-step in the process of eliminating grain boundaries from a channel region according to one embodiment of Shimizu, and not a completed device of final product. Furthermore, a review of the cited sections of the reference indicates that, according to Shimizu, the electric characteristics of a thin film transistor (TFT) are greatly affected by the grain boundary in a field region and therefore, the electric characteristics of the TFT are improved by increasing the grain size of polysilicon for the channel to reduce the number of grain boundaries (column 1, lines 27-29 and 38-41). To do so, Shimizu teaches a method by which a heat treatment is applied in several stages to convert the amorphous silicon into polysilicon with the remaining polysilicon film as a seed crystal (column 2, lines 62-64). Accordingly, the electric characteristics of a TFT can be improved since there are **no small grains** in the channel portion as in a conventional case (column 7, lines 21-32). In other words, Shimizu improves the electric characteristics of a TFT by completely eliminating small grains in the channel portion, that is, Shimizu eliminates secondary crystal grain boundaries in the channel portion by repeatedly applying a heat treatment (column 13, lines 20-30). Furthermore, Shimizu limits the number of primary crystal grain boundaries in the channel portion by increasing the size of the grain. As such, Shimizu is not concerned with forming crystal grain boundaries perpendicular to other crystal grain boundaries in many different ways as alleged by the Office Action but rather Shimizu is concerned with eliminating small grain boundaries in the channel portion and reducing the number of primary grain boundaries in the channel region by enlarging as much as possible the grains. This process for eliminating the crystal boundaries is seen in Fig. 51 of Shimizu.

Accordingly, Applicants respectfully note that the reasoning of the Examiner to combine Mitanaga with Shimizu to teach the features recited in independent claim 1 appears to be incomplete, since no explanation is provided as to what relationship exists between forming crystals in a predetermined direction, as taught by Mitanaga, and enlarging the size of a crystal, as taught by Shimizu.

The failure to provide such an explanation, coupled with the fact that Shimizu does not, in fact, disclose forming crystal grain boundaries perpendicular to other crystal grain boundaries in many different ways, leaves one with the conclusion that Shimizu does not disclose the features recited in independent claim 1.

Therefore, Applicants respectfully assert that the combination of Mitanaga and Shimizu do not disclose or suggest the features of the claimed invention. Thus, the rejection of claim 1 is traversed.

Regarding the rejections of claims 2-5, 7 and 8, it is noted that these claims depend from claim 1. Thus, the rejections of these claims are traversed for at least the reasons set forth above.

Regarding the rejection of independent claim 11, it is noted that claim 11 recites a display device comprising, amongst other novel features, a driving region; a plurality of thin film transistors in the driving region; primary crystal grain boundaries in the polysilicon substrate in the driving region; and secondary crystal grain boundaries in the polysilicon substrate in the driving region; wherein the primary crystal grain boundaries are inclined to a direction of current flowing from source to drain of each of the plurality of thin film transistors at an angle of 30° to 150° and the secondary crystal grain boundaries are substantially parallel to the current flowing from the source to the drain.

The Office Action recognizes that Mitanaga fails to teach or suggest the features of the primary crystal grain boundaries being inclined in a direction of current flowing from source to drain of each of the plurality of thin film transistors at an angle of 30° to 150° and the secondary crystal grain boundaries being substantially parallel to the current flowing from the source to the drain. The Office Action relies on Shimizu for such teachings and in particular in Fig. 44. However, as noted above, Fig. 44 of Shimizu illustrates a step in the process of eliminating grain boundaries from a channel region (column 13, lines 18-31) and not a finish product as recited in the independent claim. Furthermore, the line which the Examiner alleges to be a primary crystal grain boundary, illustrated in Fig. 44, is not a primary crystal grain boundary but rather a line denoting an area which is heat treated.

Accordingly, Applicants respectfully note that the reasoning of the Examiner to combine Mitanaga with Shimizu to teach the features recited in independent claim 11 appears to be incomplete, since no explanation is provided as to what relationship exists between forming crystals in a predetermined direction, as taught by Mitanaga, and eliminating the crystal grain

boundaries, as taught by Shimizu.

Accordingly, Applicants respectfully assert that the rejection of claim 11 under 35 U.S.C. § 103(a) should be withdrawn because neither Mitanaga nor Shimizu, whether taken singly or combined, teach or suggest each feature of independent claim 11.

Regarding the rejection of independent claim 12, it is noted that claim 12 recites a display device comprising, amongst other novel features, primary crystal grain boundaries formed in the display region and inclined to a direction of current flowing from source to drain at an angle of -30° to 30° and the secondary crystal grain boundaries formed in the display region substantially perpendicular to the current flowing from the source to the drain; and the primary crystal grain boundaries formed in the driving region inclined to a direction of current flowing from source to drain at an angle of 30° to 150° and the secondary crystal grain boundaries formed in the driving region substantially parallel to the current flowing from the source to the drain.

The Office Action recognizes that Mitanaga fails to teach or suggest the features of the primary crystal grain boundaries being inclined in a direction of current flowing from source to drain of each of the plurality of thin film transistors at an angle of -30° to 30° and the secondary crystal grain boundaries being substantially parallel to the current flowing from the source to the drain. The Office Action relies on Shimizu for such teachings and in particular in Fig. 44. However, as noted above, Fig. 44 of Shimizu illustrates a step in the process of eliminating grain boundaries from a channel region (column 13, lines 18-31) and not a finished product as recited in the independent claim. Furthermore, the line which the Examiner alleges to be a primary crystal grain boundary, illustrated in Fig. 44, is not a primary crystal grain boundary but rather a line denoting an area which is heat treated.

Accordingly, Applicants respectfully note that the reasoning of the Examiner to combine Mitanaga with Shimizu to teach the features recited in independent claim 12 appears to be incomplete, since no explanation is provided as to what relationship exists between forming crystals in a predetermined direction, as taught by Mitanaga, and eliminating the crystal grain boundaries, as taught by Shimizu.

Accordingly, Applicants respectfully assert that the rejection of claim 12 under 35 U.S.C. § 103(a) should be withdrawn because neither Mitanaga nor Shimizu, whether taken singly or combined, teach or suggest each feature of independent claim 12.

CONCLUSION:

There being no further outstanding objections or rejections, it is submitted that the application is in condition for allowance. An early action to that effect is courteously solicited.

Finally, if there are any formal matters remaining after this response, the Examiner is requested to telephone the undersigned to attend to these matters.

If there are any additional fees associated with filing of this Amendment, please charge the same to our Deposit Account No. 503333.

Respectfully submitted,

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